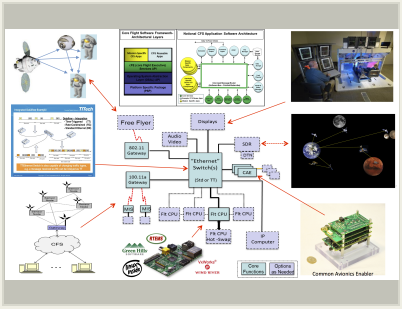
Avionics Architecture for Exploration (AAE)

Completed Technology Project (2012 - 2014)

Project Introduction

The goal of the AES Avionics Architectures for Exploration (AAE) project is to develop a reference architecture that is based on standards and that can be scaled and customized. The architecture will contain basic core elements and functionality needed for any spacecraft. The goal for specific mission implementation is that the avionics will be 80% core AAE elements and 20% unique. The AAE project will also focus on the affordability and maintainability of the avionics systems. The project will take into account design, development, test and evaluation (DDT&E) costs, maintenance costs, upgrade flexibility, size, weight, and power (SWaP). The following architecture guidelines will be followed: Minimize SWaP for Avionics in Flight Vehicle Use wireless where possible Minimize wire weight Use low/no power sensors Pick a topology that keeps the processors close to what they control Minimize Cost Use existing capabilities to avoid near-term DDT&E Allow for growth using new technology to avoid future DDT&E Allow for infusion of new technology to reduce sustaining costs Minimize Risk (multi-faceted) Use proven technology for critical functions Use existing capabilities to minimize schedule risk NASA should develop and own the Reference Architecture Develop a reference implementation of the architecture that can be provided to industry as a basis for standards (Note: this project started as Common Avionics but the name was changed. All data pertaining to the Common Avionics project has been incorporated into this project.) The results of this project will be incorporated into the AES Avionics and Software project.

The AAE project team will develop a system-level environment and architecture that will accommodate equipment from multiple vendors in order to benchmark performance for missions beyond low Earth orbit (LEO). This will allow NASA to take advantage of strides being made by industry to drive our development and sustaining costs down. The project team will also evaluate emerging technologies in industry and academia to ensure that other potentially beneficial concepts are not overlooked. The reference architecture will be developed by dividing it into three core areas: Command and Data Handling (C&DH), Communications, and Human Interfaces. The hardware selected for these core areas will typically be high TRL and currently available. The hardware must also have lineage that gives the team confidence that a radiation tolerant version that can survive the environment beyond Earth orbit will be available within a reasonable time. The C&DH Team will focus on the areas of single board computers, network architecture and hardware, instrumentation systems, and hardware/network standards. They will address radiation tolerance issues with higher performance processors that are required to support the demands of human exploration. Various network technologies will be investigated for critical and non-critical applications. The Communications Team will focus on developing a communications architecture that will operate over multiple mission phases and across various users, including international partners. They will take into account communications amongst several vehicles, EVA, and the ground. The communications team will



Avionics Architecture for Exploration

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Exploration Capabilities

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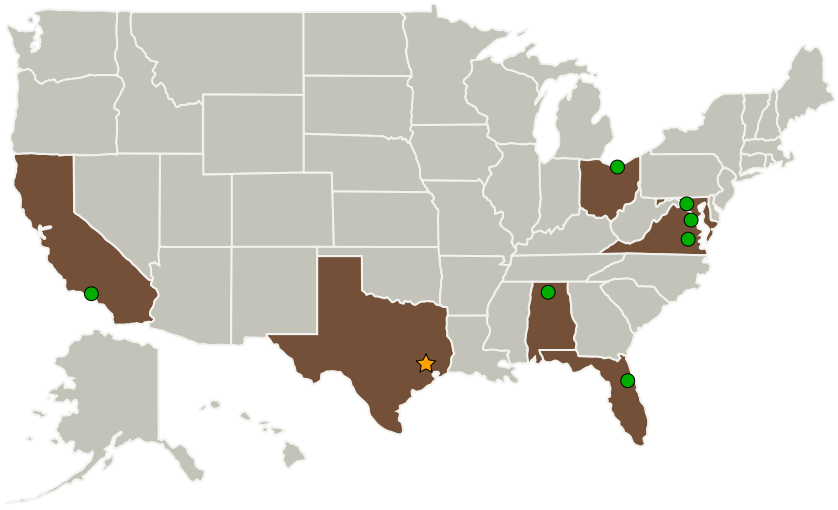
consider systems that support multiple formats, reconfigurability, adaptive power control, and other cognitive capabilities as well as utilize wireless technology where possible to reduce vehicle weight (less wires). The system will have to address the high data rate demands of human exploration. The communications team will evaluate existing communications hardware from industry and other centers. They will also consider existing agency and international standards. The Human Interface Team will address the great challenge of providing displays, audio systems, video systems, and controls that will reliably function in the environment beyond low Earth orbit. They will evaluate new display technologies (such as OLEDs) and Graphics Processing Unit options (including a software GPU). Off-the-shelf video and audio systems will be evaluated for performance, integration within the architecture, and environmental concerns. These three teams will work together to produce a reliable and flexible reference avionics architecture that will be demonstrated in the Integrated Power, Avionics, and Software (iPAS) laboratory at JSC. The iPAS laboratory will provide an excellent place to infuse and validate new architectural components of the avionics architecture. The lab can support multiple vehicles of various avionics implementations communicating together in a mission scenario. Three integrated tests are planned throughout FY14 as the avionics architecture evolves.

Anticipated Benefits

Quicker systems development and reduced costs.

Primary U.S. Work Locations and Key Partners



Project Management

Program Director:

Christopher L Moore

Project Manager:

James E Ratliff

Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.2 Reasoning and Acting
    - TX10.2.3 Motion Planning

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Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
●Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
●Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
●Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
●Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
●Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
●Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
●NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, District of Columbia

Primary U.S. Work Locations	
Alabama	California
District of Columbia	Florida
Maryland	Ohio
Texas	Virginia

Project Transitions

October 2012: Project Start

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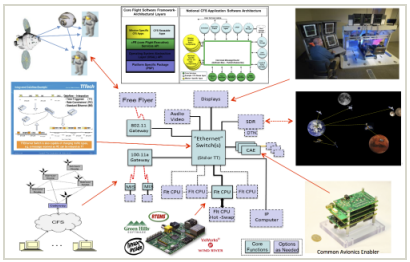
Completed Technology Project (2012 - 2014)

September 2014: Closed out

Closeout Summary: To request closeout information for this project, please send an email with the Subject "TechPort Closeout Report Request" to hq-aes@mail.nasa.gov and specify which project closeout report you are requesting.

Images



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